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1/22/05

Dear Mr. Shun Lee, Examiner: (571-272-2439)
Thank you for your comments and the conversation on conference call. The key difference of my invention with other patents referenced is the design shown in Fig. 6B. My design uses a common optical aperture to provide both optical and electronic VIS/I^2 and LIR image fusions in two wavebands from the same target simultaneously in real time without parallax. The common optical aperture can be a refractive objective lens (see Fig. 3B), a common beam splitter (see Fig. 4B), or a reflective objective lens consisting of a concave mirror and a flat mirror or a concave mirror and a convex mirror (see Fig. 5B). The fused images can be overlapped pixel by pixel or displayed side by side. All patents referenced do not have this unique optical plus electronic fusion simultaneously. The big advantage of this design is that the pixel-by-pixel electronic fusion can be used by computer for image processing (such as subtraction) and automatic target recognition (ATR), and the side-by-side optical fusion can be observed by the user to see the image difference (such as contrast) from two bands. As examples, Figure 1 is our pixel-by-pixel electronic fusion images from CCD and LIR but displayed in the format of picture-in-picture. Figure 2 is our side-by-side or partially overlapped optical fusion images from I^2 and LIR that will not reduce the high resolution of the I^2.

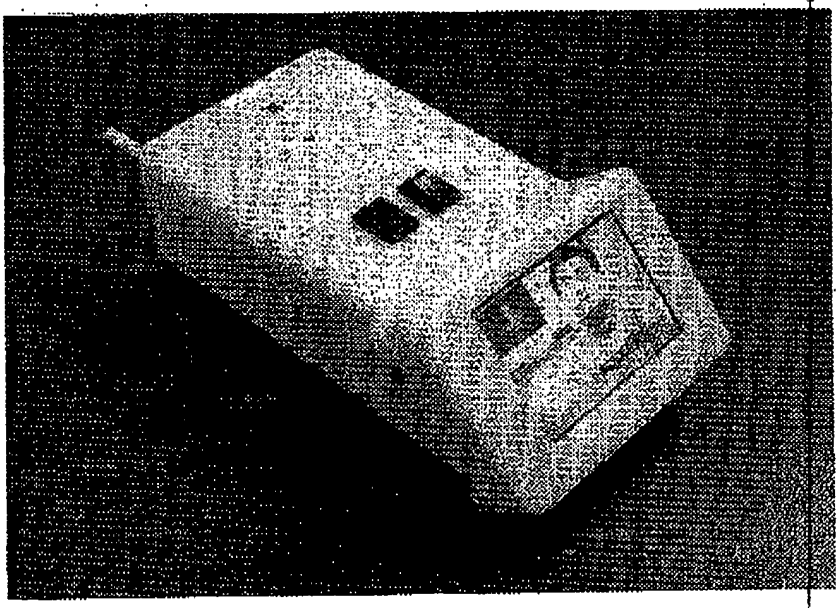

Figure 1. Our handheld pixel-by-pixel CCD and LIR sensor fusion system

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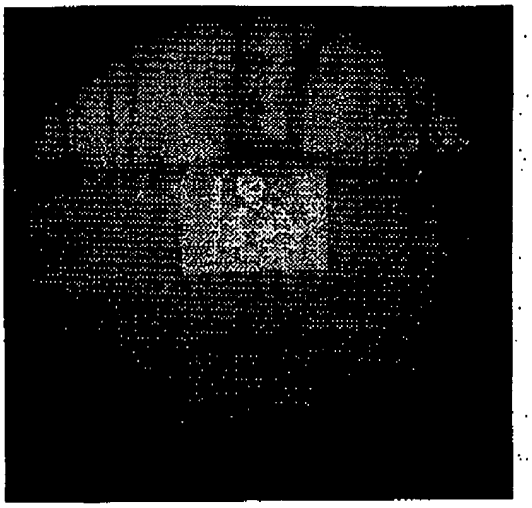

Fig. 2a. Picture-in-picture I^2 (a guard wearing green uniform with low contrast) and LIR (white, high contrast) image fusion (partial overlapping)

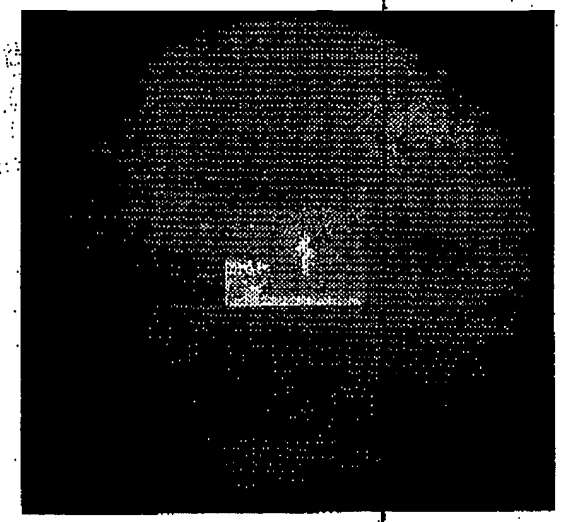

Fig. 2b. Side-by-side image fusion of a jeep and a guard under bush (the I^2 image on left is hard to see but their LIR images on right are clear)

Wolff uses a common refractive objective lens to realize PiP electronic fusion for I^2CCD and LIR, but the resolution of I^2 will be largely reduced by the CCD. Night Vision Lab does not like this kind fusion. NVL prefers our optical fusion shown in Figure 2. In addition, Wolff does not have our common beam splitter and common reflective objective lens approaches. Of course he also does not have electronic and optic fusions simultaneously.

Fergason can partially overlap (not PiP) the direct image with a projected image from one sensor such as CCD (not from CCD/I^2 and LIR two sensors in our design) and cannot get the high resolution image from I^2 because he must digitize the signal from the sensor and display on the screen then can project it. He cannot use computer to process the direct image. Of course, he also does not have electronic and optic fusions simultaneously.

Although Horn talked about using a collimated lens (should be an objective lens) to collimate (should be image) the input radiation onto two FPAs, without knowing how can he design the wide band collimated lens from 0.4 to 12 μ and how can he separate the VIS and LIR bands without using a beam splitter, no body will know how can he achieve his statement. Of course his electronic fusion cannot keep the high resolution of the I^2 even his design is for night vision goggle (almost no I^2CCD for military use). Unlike my design he also does not have electronic and optic fusions simultaneously.

Yona talked about to use a beam splitter to combine two images on user's eye (see his Fig. 1A); these images are from different targets even from tape it is completely different from our image fusion from the same target in real time. In addition, our common beam splitter (see our Fig. 4B) is put in the front of two sensors (images) so we have the common optical aperture to remove the parallax; his beam splitter is put behind two

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images so it is not a common optical aperture and cannot do image fusion from one target. Of course he also does not have electronic and optic fusions simultaneously.

Chipper has an objective lens design for infrared with narrow band but not for both VIS and LIR in wide band. In addition, between two sets of lenses he does not have a beam splitter like us so he cannot get two channels and cannot correct aberrations in two bands. Of course his design is not for sensor fusion.

Chambers has an electronic circuit design but not for sensor fusion.

Although Owen can design aberration correction lenses, that is for one narrow band not for two bands with sensor fusion. Our design uses the first lens piece made by ZnSe in 0.4 – 12 μ as common optical aperture for both VIS and LIR bands, insert a beam splitter to separate them, then use a lens made by common glass to correct the aberration only in 0.4 – 0.9 μ for CCD and use a lens made by Ge to correct the aberration only in 8 – 12 μ for LIR that is a brand new and feasible approach. Otherwise to design a lens to correct the aberrations in the wide band from 0.4 – 12 μ is very difficult.

Dear Mr. Lee, from the above you can see that my invention is quite different from others. Every patent has its own claims and limitations. You cannot combine all of them together against me. Otherwise nobody can create a patent. If I use common beam splitter to make a product having both electronic and optic fusions, can Wolff sue me? He cannot, because he does not have common beam splitter, does not have optical fusion, and does not have optic and electronic fusion simultaneously. He cannot say "somebody has optical fusion so I sue you!"

However, I respect your comments. Although I have already spent more than $10K for attorney, I still plan to give up all old claims and only keep the claim for simultaneous optic and electronic fusion shown in Fig. 6B. If it makes sense, please let me know so I can prepare a few new claims by myself that will not have conflict with patents referenced. Thank you for your kind consideration and prompt reply.

Sincerely,

Evan Zhang, Ph.D.